Calorimetry

1. A calorimeter was calibrated with an electric heater, which supplied 22.5 kJ of energy to the calorimeter and increased the temperature of the calorimeter and its water from 22.45°C to 23.97°C. What is the heat capacity of the calorimeter?

2. When 0.113 g of benzene, C_6H_6, burns in excess oxygen in a calibrated constant-pressure calorimeter with a heat capacity of 551 J/°C, the temperature of the calorimeter rises by 8.60°C. Write the thermochemical equation and calculate the reaction enthalpy for $2\ C_6H_6(l) + 12\ O_2(g) \rightarrow 12\ CO_2(g) + 6\ H_2O(l)$.

3. A reaction known to release 2.00 kJ of heat takes place in a calorimeter containing 0.200 L of solution and the temperature rose by 4.46°C. When 100 mL of nitric acid and 100 mL of sodium hydroxide were mixed in the same calorimeter, the temperature rose by 2.01°C. What is the heat output for the neutralization reaction?
   The chemical equation is $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$.

4. When a solution of 1.691 g of silver nitrate is mixed with an excess of sodium chloride in a calorimeter of heat capacity 216 J/(°C) [1], the temperature rises 3.03°C. What is the reaction enthalpy for $NaCl(aq) + AgNO_3(aq) \rightarrow NaNO_3(aq) + AgCl(s)$?

*** The next two problems deal with combustion reactions. When reporting the molar heat or enthalpy of combustion for a certain fuel, one assumes the value of the heat of combustion or enthalpy of combustion is per 1 mole of the fuel. ***

5. If we set up a bomb calorimetry experiment to determine the molar enthalpy of combustion of ethane (C_2H_6) using 1 L of water as our heat sink, 2.805 g of ethane, and measure an initial and final temperature of 25.20°C and 58.92°C, respectively, what will be the experimentally determined molar enthalpy of combustion of ethane? The chemical equation is $2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$? Assume the density of the water is 1.00 g/mL. Assume the calorimeter itself absorbs no heat. The specific heat capacity of water is 4.184 J/(g*K).

6. 1.14 g of octane (C_8H_{18}) is combusted in a bomb calorimeter surrounded by 1 L of water. The initial and final temperatures of the water are 25°C and 33°C respectively. The heat capacity of the calorimeter hardware (all of the calorimeter except for the water) is 456 J/(°C).
   The chemical equation is $2\ C_8H_{18} + 25\ O_2 = 16\ CO_2 + 18\ H_2O$.
   Determine the molar enthalpy of combustion of octane.